



Southeast Asian Fisheries
Development Council
Training Department

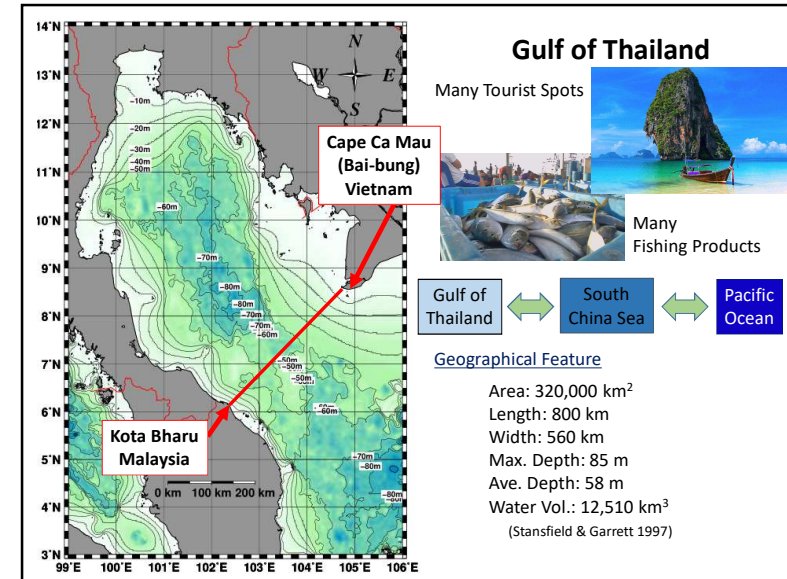
Hokkaido University
Fisheries



University Training Course#63 (การฝึกอบรมระยะสั้นรุ่นที่ 63)

Oceanographic Features in the Gulf of Thailand

19th of April 2023 by Hiroji Onishi
onishi@fish.hokudai.ac.jp





**Competition of Sea Area
(and greatest depth)**

Gulf of Thailand: 320,000km²/85m

Sea of Japan: 978,000km²/3,742m

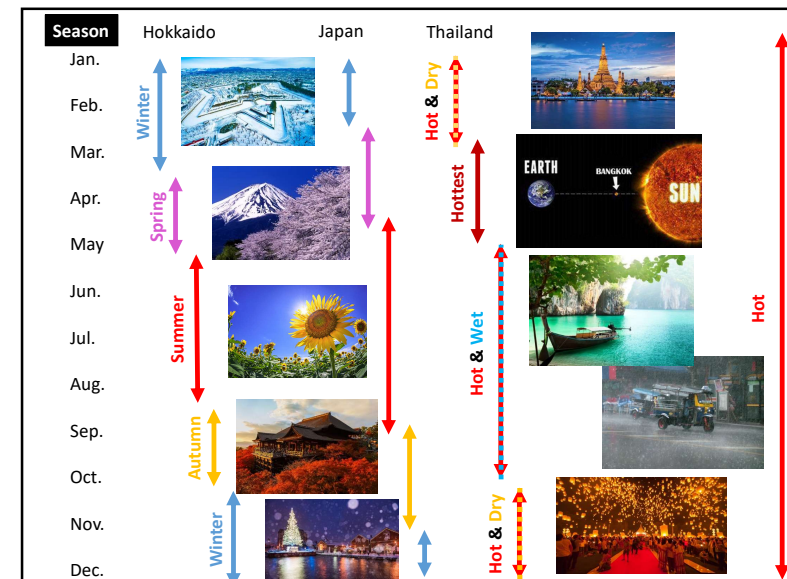


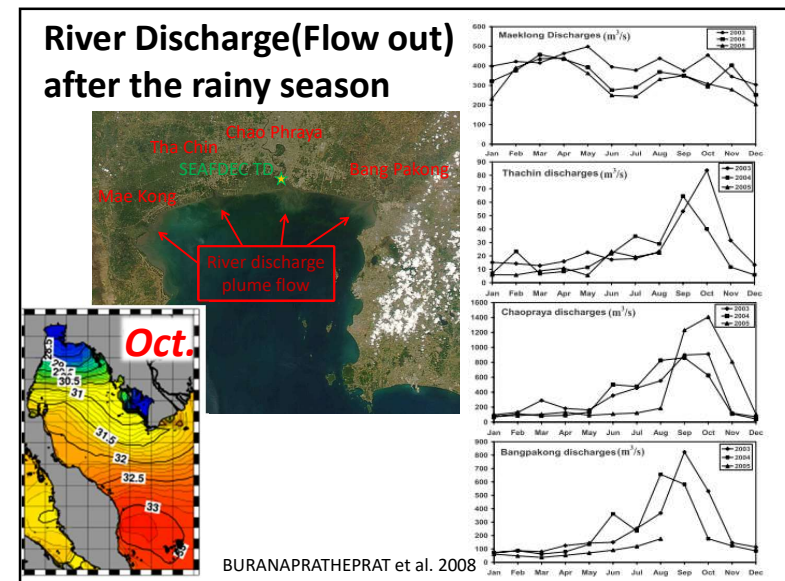
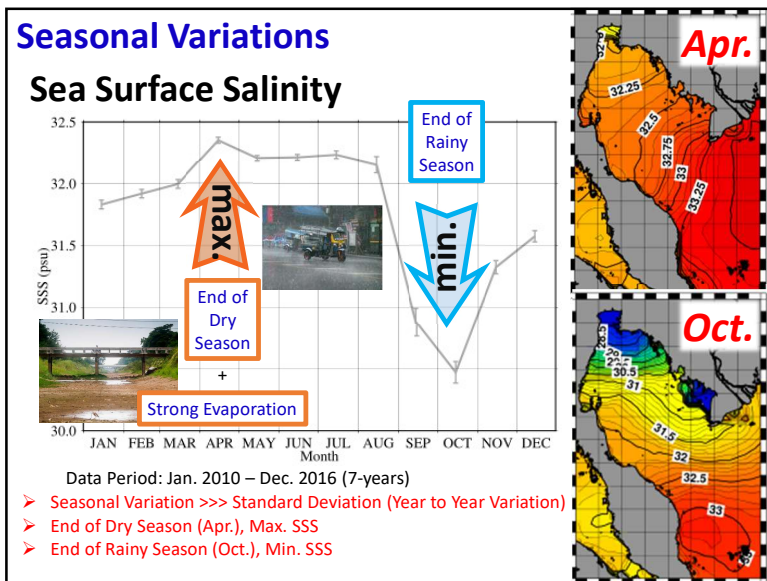
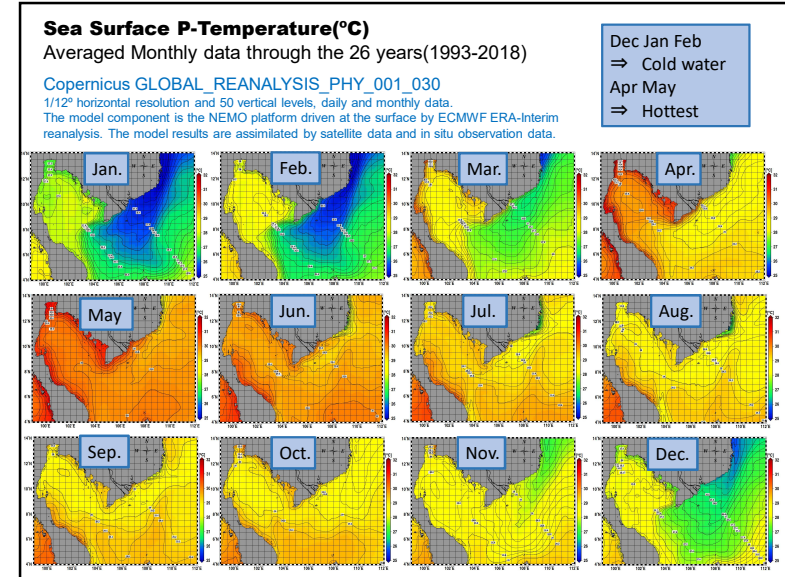
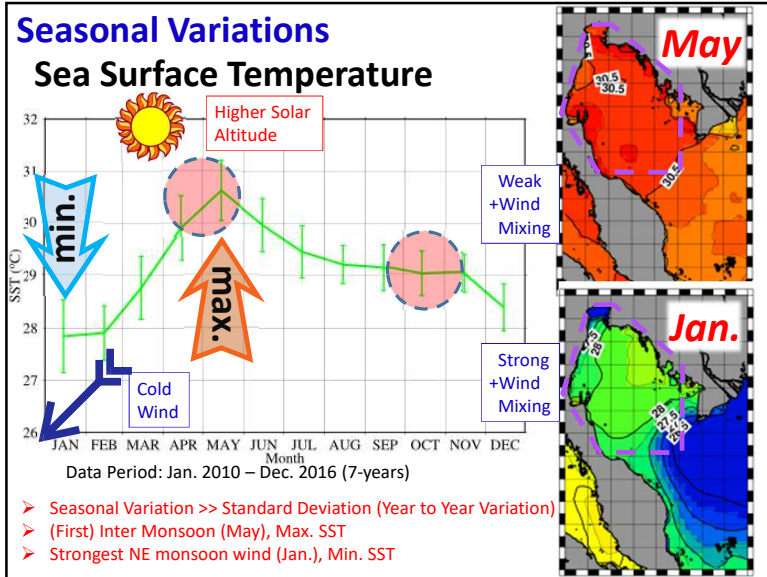
**Competition of Land Area
(and highest mountain)**

Thailand: 513,120km²/2,576m(Doi Inthanon)

Japan: 377,972km²/3,776m(Mount Fuji)





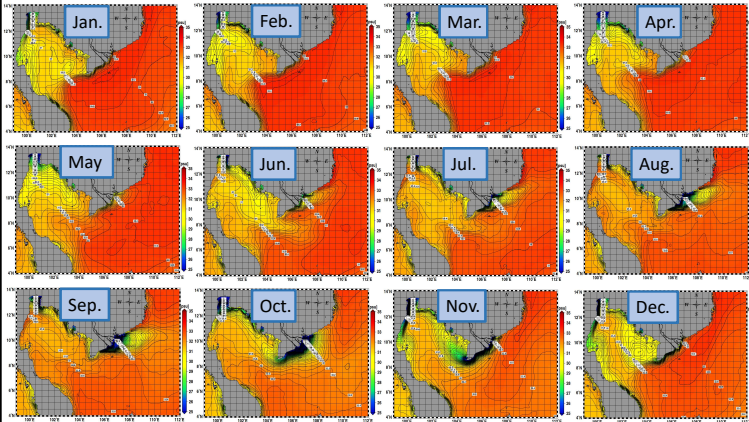
Sea Surface Salinity(psu)

Averaged Monthly data through the 26 years(1993-2018)

Copernicus GLOBAL_REANALYSIS_PHY_001_030

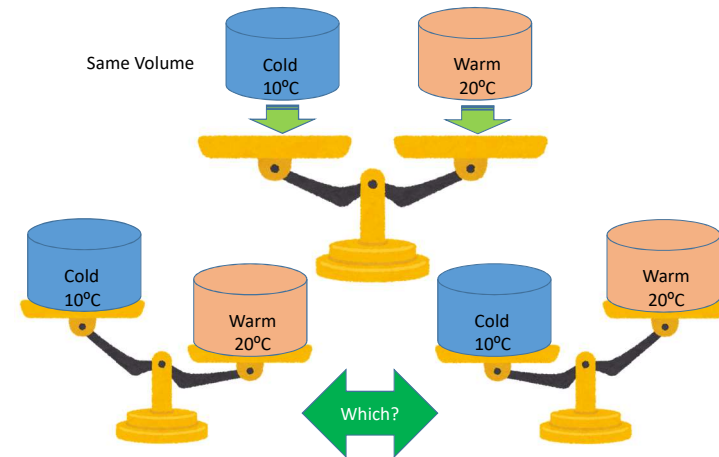
1/12° horizontal resolution and 50 vertical levels, daily and monthly data.
The model component is the NEMO platform driven at the surface by ECMWF ERA-Interim reanalysis. The model results are assimilated by satellite data and in situ observation data.

Oct. • Nov.
⇒ Lowest water
Jan. • Feb. • Mar.
⇒ Sal. Front



Question 1

Which is heavier, Same Volume **Cold water** or **Warm water** ?

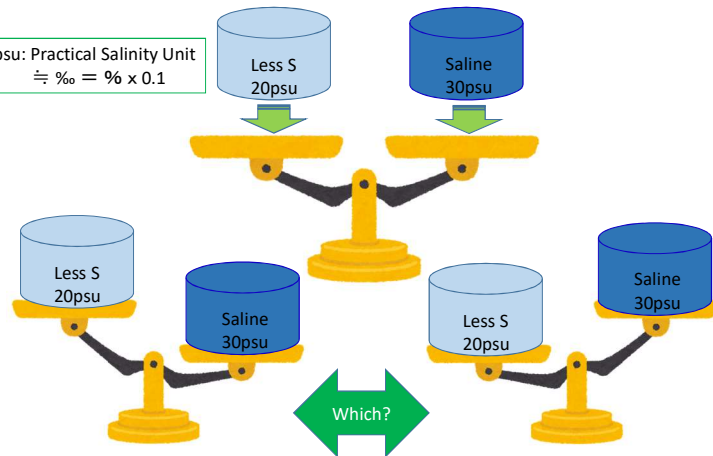


Question 2

Which is heavier, Sama Volume **Less-saline water** or **Saline water** ?

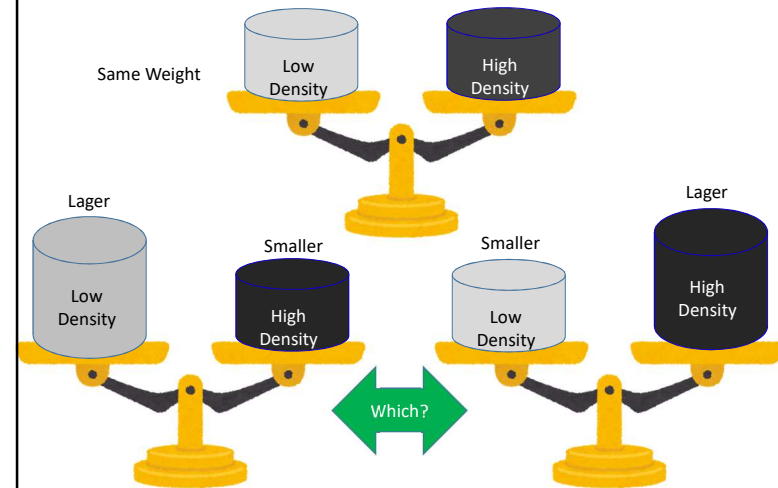
Saline: Higher salinity contents

psu: Practical Salinity Unit
≡ ‰ = ‰ × 0.1

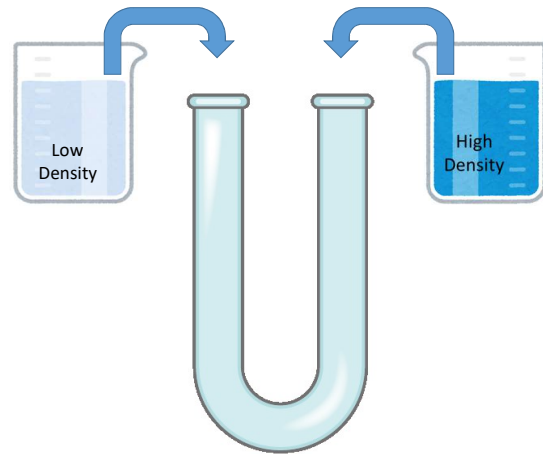


Question 3

Which is larger, Same Weight **Low-density water** or **High-density water** ?



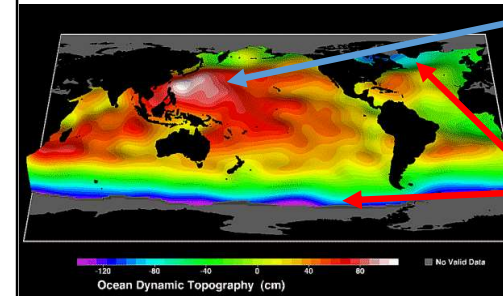
Question 4 Which is higher, **Low-density water** or **High-density water** in a U-tube, when it balanced in a tube ?



Question 5



Sea surface looks like a flat plane, but by more widely view from space, there are many bumps, Sea surface is not flat (uneven!).



In a **high** water level area, What kind of sea water there ?

In a **low** water level area, What kind of sea water there ?

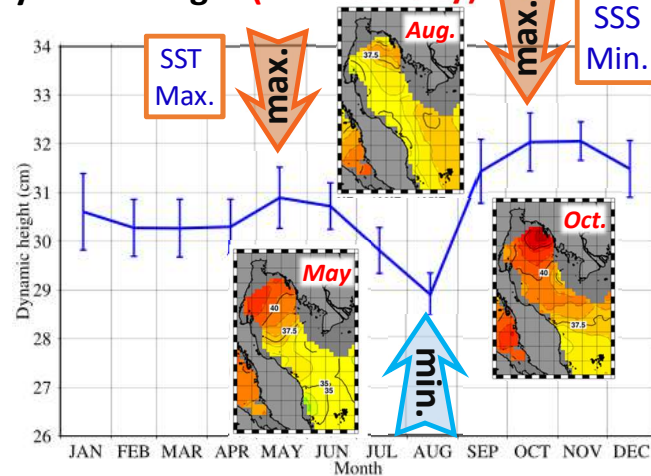
High water level area is over +100cm

Low water level area is under -100cm

Seasonal Variations

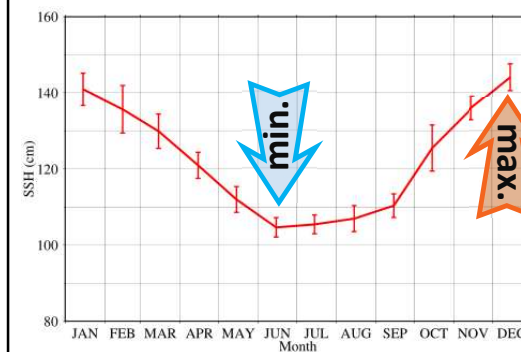
Data Period: Jan. 2010 – Dec. 2016 (7-years)

Dynamic Height (from density)



Seasonal Variations

Sea Surface Height – from Satellite altimeter



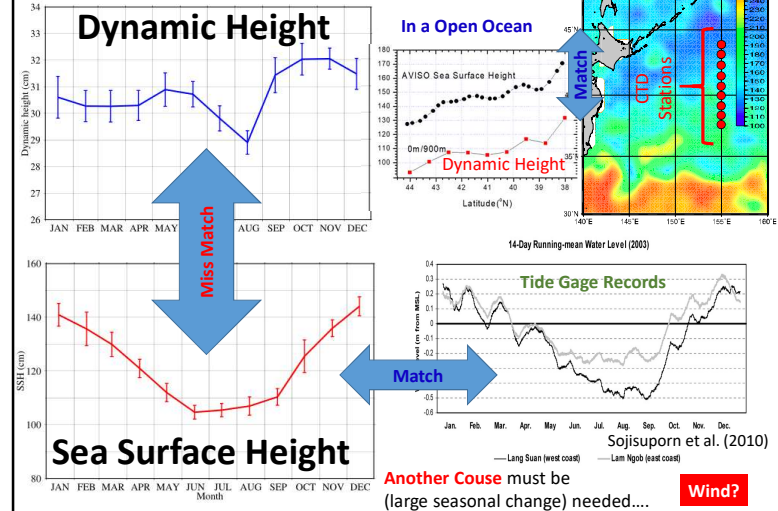
- Seasonal Variation >> Standard Deviation (Year to Year Variation)
- Dec. - Jan. : Max. SSH
- Jun. - Jul. : Min. SSH
- Over 30cm difference

These do not correspond to the Dynamic Height change

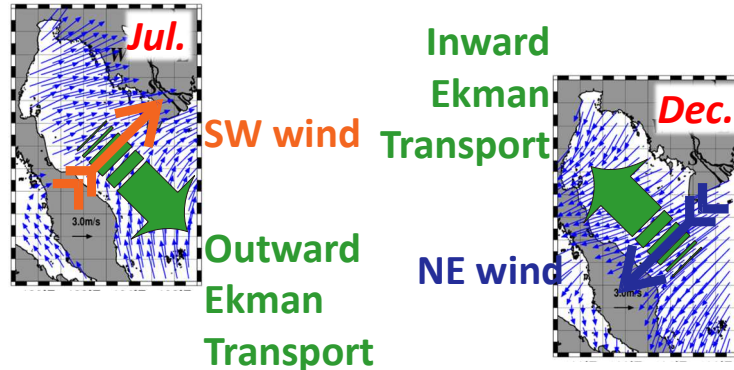
Averaged Monthly data through the 26 years(1993-2018)

1/12° horizontal resolution and 50 vertical levels, daily and monthly data.

Dynamic Height

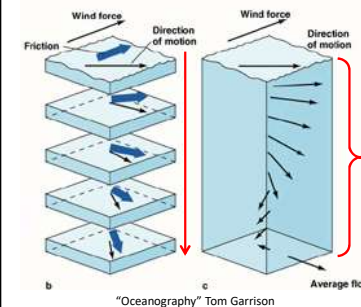


NE Monsoon Season



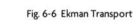
What is “Ekman Transport” ?

**Vagn
Walfrid
Ekman
(1874-1954)**



Directly
effected by
wind, =>
Ekman Layer

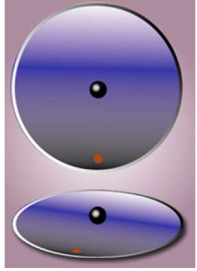
10-100m
depth



Net water transport in Ekman Layer is right-hand side to wind direction in northern hemisphere

What is "Coriolis Force" ?

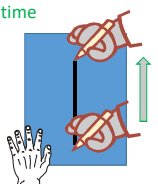
is an **inertial** or **fictitious** force that acts on objects in motion within a frame $\Rightarrow$ the Earth



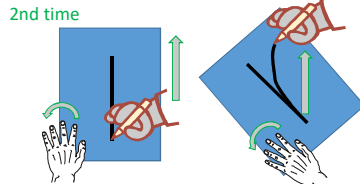


Gustave de Coriolis
(1792-1843)
French, Scientist

1st time



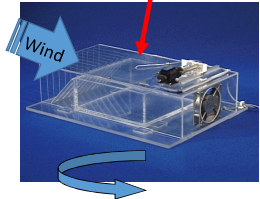
2nd time



What is "Ekman Transport" ?

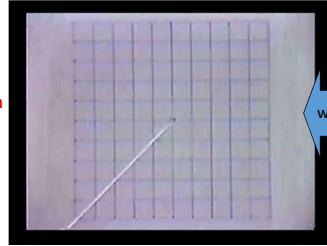
Experiment of Ekman Spiral

input a drop of red ink at the center of water tank

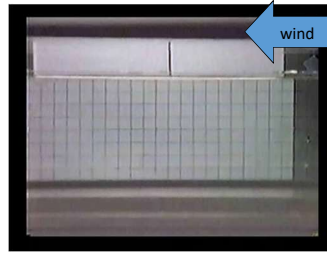
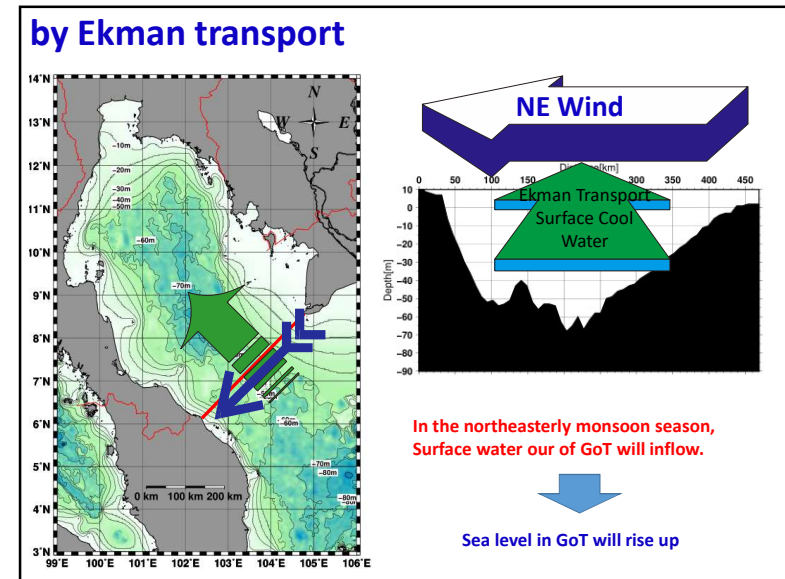
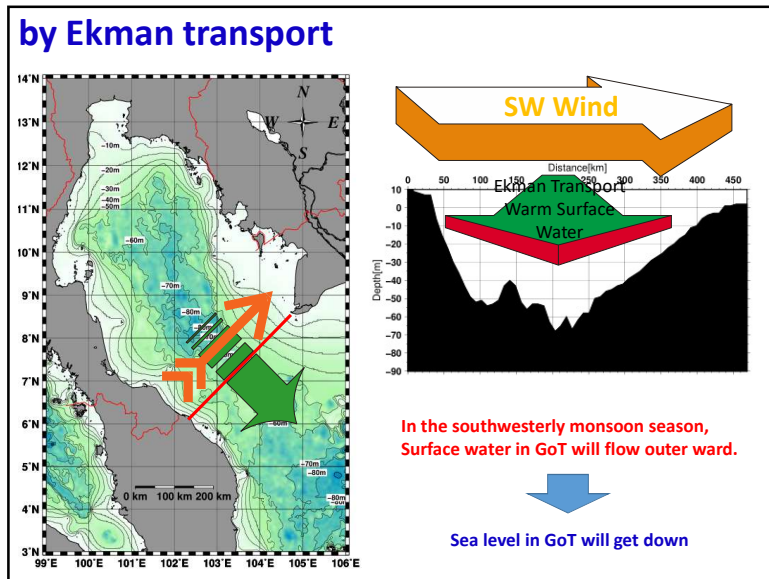


on a rotating table anticlockwise $\Rightarrow$ Northern hemisphere

View from above



View from Side

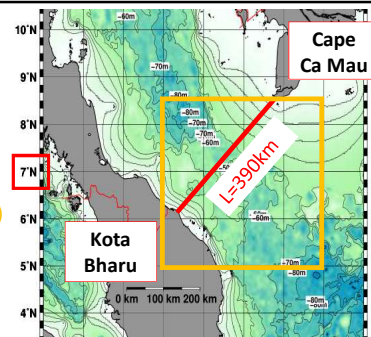
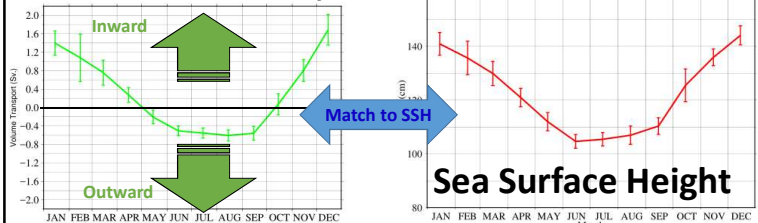



Ekman Transport[Sv]

$$E. T. = \frac{\tau}{\rho f} \times L \times 10^{-6}$$

τ : Wind Stress (Monthly Ave.)
 ρ : Surface Density (Monthly Ave.)
 f : Coriolis Parameter (at 7°N)
 L : Fetch(390km)

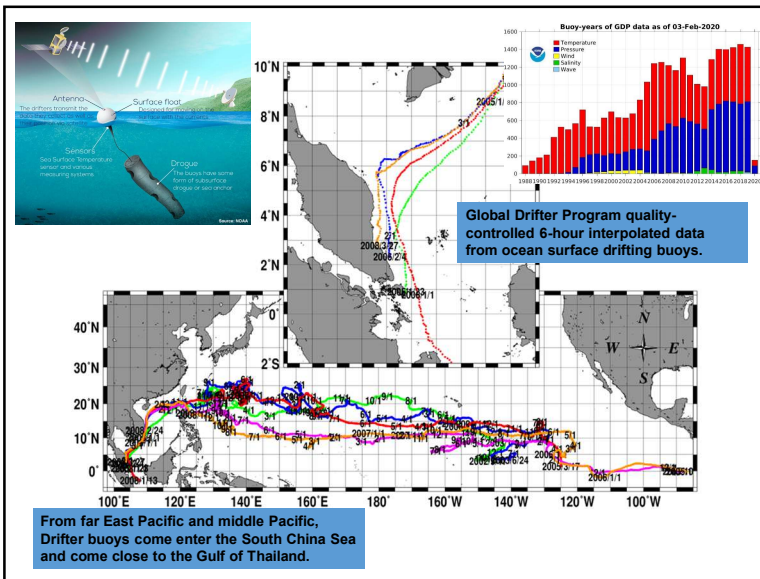
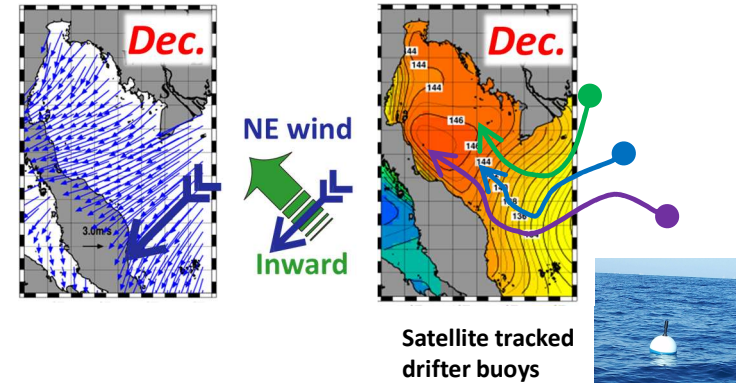
Ekman Volume Transport



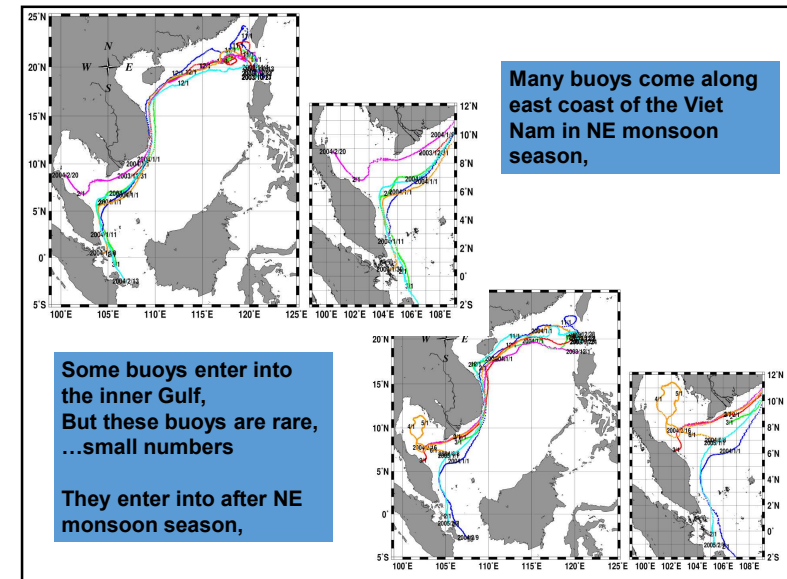
Ekman Transport[Sv] $E. T. = \frac{\tau}{\rho f} \times L \times 10^{-6}$

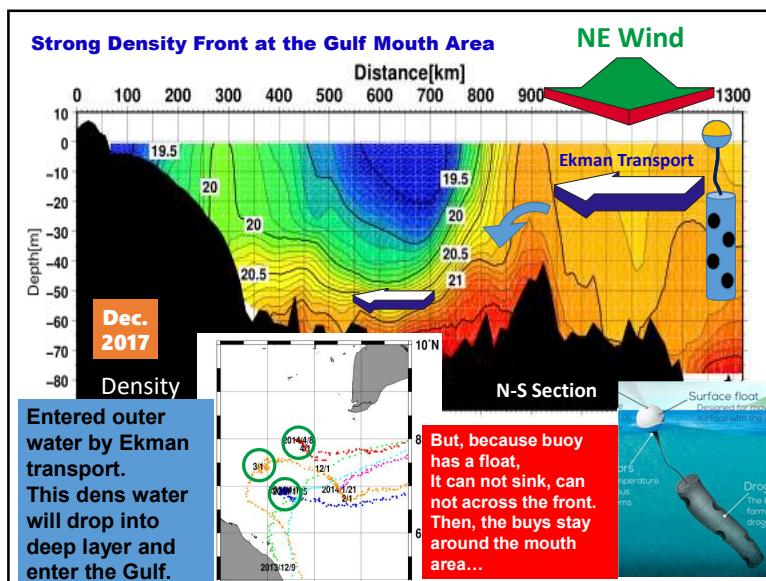
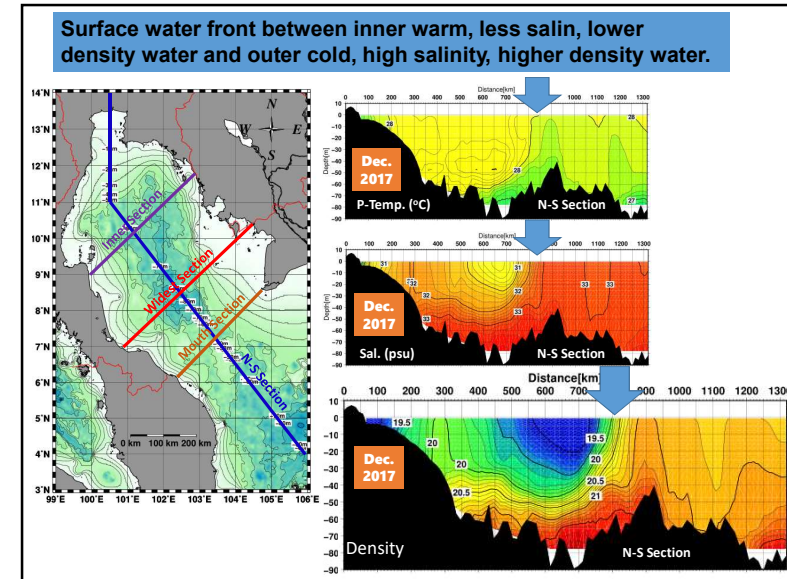
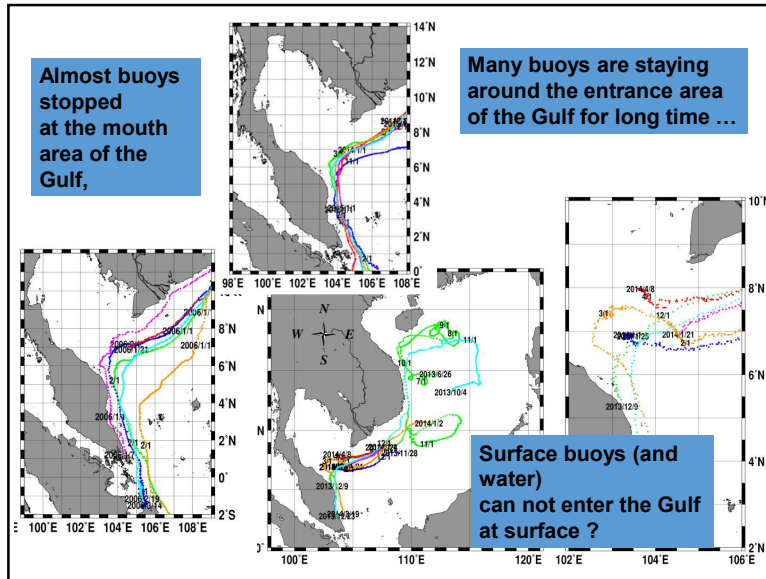
τ : Wind Stress, ρ : Surface Density,
 f : Coriolis Parameter, L : Fetch

As a next step ...
Conform inflow water
by drifter buoys data



From far East Pacific and middle Pacific, Drifter buoys come enter the South China Sea and come close to the Gulf of Thailand.





Summary

- Water in the GoT shows obvious seasonal variation.
 - Inter monsoon, warmest SST, weak wind effect.
 - SW monsoon, surface warm water flow out by Ekman transport.
 - NE monsoon, cold saline water come to GoT mouth area from South China Sea.
- This dens water sink at density front and flow into deep layer under less-dens GoT inner water.

- How about the effect to ecosystem in GoT?
- How about the water distribution pattern in GoT?